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(54) **Synergistic herbicide combinations and method of application.**

(57) A synergistic herbicidal composition comprising a mixture of: (a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and (b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

EP 0 230 596 A2

SYNERGISTIC HERBICIDE COMBINATIONS AND METHOD OF APPLICATION

Background of the Invention

The protection of crops from weeds and other vegetation which inhibit crop growth is a constantly recurring problem in agriculture. To help combat this problem researchers in the field of synthetic chemistry have produced an extensive variety of chemicals and chemical formulations effective in the control of such unwanted growth. Chemical herbicides of many types have been disclosed in the literature and a large number are in commercial use.

In some cases, active herbicides have been shown to be more effective in combination than when applied individually. The result is often termed "synergism," since the combination demonstrates a potency or activity level exceeding that which it would be expected to have, based on a knowledge of the individual potencies of the components. The present invention resides in the discovery that certain cyclohexanediones and other chemical compounds already known individually for their herbicidal potency, display this synergism when applied in combination.

The Prior Art

The compounds which can be combined to form the synergistic herbicidal compositions of this invention are already known in the art as herbicides. One such compound is 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione. This compound is disclosed in European Patent Publication No. 013,796, published 4-4-85. It is also disclosed and claimed in U.S. Application Serial No. 634,408. Another of the compounds used in the synergistic compositions of the invention is 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, commonly known as Atrazine. Still another compound used in the synergistic herbicidal compositions of this invention is 3-amino-2,5-dichlorobenzoic acid, commonly known as Chloramben, described and claimed in U.S. Patents 3,014,063 and 3,174,842. Yet another compound used in the synergistic compositions of this invention is 2-chloro-4-N-isopropylacetanilide, commonly known as Propachlor.

Description of the Invention

It has now been discovered that synergism in the control of undesirable vegetation is exhibited by compositions comprising a mixture of the following components:

a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexandione; and

b) a herbicidally effective amount of a compound selected from the group consisting of 3-(amino-2,5-dichlorobenzoic acid, 2-chloro-N-isopropylacetanilide or 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, and mixtures thereof.

Another embodiment of this invention is a method of controlling undesirable weed pests, and this method comprises applying the synergistic compositions of the invention to the locus where control is desired.

The terms "synergism" and "synergistic" are used herein to convey the result observed when a combination of herbicides demonstrates a potency in excess of that which the combination would be expected to produce on the basis of the potencies of each herbicide applied individually.

The term "herbicide" is used herein to denote a compound which controls or modifies the growth of plants. The term "herbicidally effective amount" is used to indicate the quantity of such a compound or combination of such compounds which is capable of producing a controlling or modifying effect. Controlling or modifying effects include all deviations from natural development, for example: killing, retardation, leaf burn, dwarfing and the like. The term "plants" is used to include all post-emergent vegetation, ranging from seedlings to established vegetation.

As previously mentioned, the synergistic compositions of this invention all employ chemical compounds previously known for their herbicidal activity. One of these compounds, 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione, is disclosed in European Patent Publication No. 013,786, published 4-4-85, and it is also disclosed and claimed in U.S. Application Serial No. 634,408. Still another compound, 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, commonly known as Atrazine, is commercially sold under various tradenames, and is described in the

Herbicide Handbook of the Weed Science Society of America, 5th Edition, 1983. Another of the compounds used in the synergistic combinations of the invention, 3-amino-2,5-dichlorobenzoic acid, is commercially available under a number of tradenames and is described on page 92 of the Herbicide Handbook of the Weed Science Society of America, 5th Edition, 1983. Yet another compound used in the synergistic compositions of this invention is 2-chloro-4-N-isopropylacetanilide, is described on pages 401 and 402 of the Herbicide Handbook of the Weed Science Society of America, 5th Edition, 1983.

These compounds are effectively used in the synergistic compositions of the invention at ratios of Compound (a) to Compound (b) as set forth above, ranging from about 0.01:1 to about 20:1. Preferably, the ratio of Compound (a) to Compound (b) is from about 0.1:1 to about 10:1.

Herbicidal Test Data

Synergism for the compositions of this invention was measured in accordance with the following test:

Aluminum pans measuring 9 x 6 x 4 inches (cm) were filled with a sandy loam soil and 6 furrows were impressed across the width of each flat. A number of weed species were seeded into furrows and covered with soil. Along with the seed species were two corn hybrids which were inserted to determine the extend of damage, if any, upon plant species.

The weed species were as follows:

Abbreviation	Common Name	Scientific Name
YNS	yellow nutsedge	Cyperus esculentus
PNS	purple nutsedge	Cyperus rotundus
RJG	rhizome johnsongrass	Sorghum halepense
FP	fall panicum	Panicum dichotomiflorum
WPM	wild proso millet	Panicum milaceum
GG	goosegrass	Eleusine indica
SC	shattercane	Sorghum bicolor
YFT	yellow foxtail	Setaria lutescens
GFT	green foxtail	Seteria viridis
PW	redroot pigweed	Amaranthus retroflexus

AMG	Annual morningglory	Ipomoea purpurea
SP	Sicklepod	Cassia obtusifolia
VL	Velvetleaf	Abutilon theophrasti
LCG	Large crabgrass	Digitaria ischaemum
JG	Johnsongrass	Sorghum halepense

The plant species were as follows:

CN	Corn	Zea maize (L.)

Chemical solutions, which in the case of pre-emergence testing were sprayed the same day of seeding, were prepared as follows:

All compounds were of technical grade, except Prowl which was what is termed a 4E formulation, which means a 4 pound per gallon emulsion concentrate. All of the technical grade compounds were either applied singly, or applied in conjunction with the synergistic herbicidal compound, by diluting the technical grade compounds with acetone and water at 1:1 ratio water and applying at a spray volume of 25 gal/acre. The quantity of active ingredient for each compounds which was applied is indicated under the heading "Application Rate".

In the case of post-emergent testing, the weed and plant species were allowed to sprout and application was made approximately 2 weeks after planting.

The various rates of application are indicated in the tables under "Application Rate".

Flats were then placed in a greenhouse, and watered by overhead sprinkling. Air temperatures ranged from 18°C to 27°C. Flats were kept moist during the course of each experiment.

After treatment, each row of seedlings was visually rated for growth control due to all factors of injury. In pre-emergence testing the ratings were done 28 days after treatment. In post-emergent testing, the rating was done 21 days after treatment. Untreated flats of seedlings were used for comparison, zero percent injury or growth control is equivalent to growth in control flats. One hundred percent growth control is equivalent to complete kill.

Herbicide interaction responses were evaluated by use of Limpel's formula (Limpel, L.E., et al., 1962, "Weed Control by Dimethyltetrachloroterephthalate Alone and in Certain Combinations," Proc. NEWCC, 16: 48-53):

$$E = X + Y - \frac{XY}{100}$$

where E = expected response
where X = observed (O) value or percent growth control when the herbicide is applied singly; and
Y = observed (O) value or percent growth control when the second herbicide is applied singly.

A response is synergistic when an observed value is greater than the calculated value, a synergistic response is understood to be one in which the interaction response is greater than the sum of responses from the individual chemical treatments. An antagonistic response is the opposite situation.

In the tables which follows:

E = expected activity
O = observed activity
R = result, i.e., additive (AD), antagonistic (A) or synergistic (S)

TABLE 1

Pre-Emergence

Treatment	Application Rate lb/A	[illegible]			[illegible]			[illegible]			[illegible]			[illegible]		
		[illegible]			[illegible]			[illegible]			[illegible]			[illegible]		
X-100	1/4	85			65			0			0					
	1/2	90			95			30			0					
ATRAZINE	1/4	0			0			0			0			0		
	1/2	0			0			0			0			0		
LASSO	1/2	100			80			0			0					
	1	100			100			0			0					
AMIBEN	1	0			0			30			0			15		
	2	0			65			50			70			25		
PROWL	1/4	0			0			20			0			0		
	1/2	0			0			0			50			10		
RAMROD	2	20			30			0			0			0		
	3	100			90			0			0			0		
X-100 + ATRAZINE	1/4+1/4	90	85	S	80	65	S	20	0	S	0	0		0	0	
	1/2+1/4	95	90	S	90	95	A	30	30	AD	0	0		0	0	
	1/2+1/2	98	95	S	95	65	S	20	0	S	0	0		0	0	
	1/2+1/2	95	90	S	95	95	AD	30	30	AD	0	0		0	0	
X-100 + LASSO	1/4+1/2	100	100	AD	95	93	S	15	0	S	0	0		0	0	
	1/2+1/2	98	100	A	85	99	A	40	30	S	0	0		0	0	
	1/4+1	95	100	A	95	100	A	20	0	S	0	0		0	0	
	1/2+1	95	100	A	100	100	AD	60	30	S	10	0		10	0	
X-100 + AMIBEN	1/4+1	95	85	S	95	65	S	20	30	A	0	0		30	15	
	1/2+1	98	90	S	98	95	S	50	51	A	40	0		30	15	
	1/4+2	95	85	S	95	88	S	30	50	A	25	70		40	25	
	1/2+2	95	90	S	98	98	AD	75	65	S	65	70		50	25	
X-100 + PROWL	1/4+1/4	95	85	S	95	65	S	10	20	A	20	0		0	0	
	1/2+1/4	95	90	S	98	95	S	55	44	S	25	0		30	0	
	1/4+1/2	95	90	S	95	95	AD	10	0	S	40	50		20	10	
	1/2+1/2	95	90	S	95	95	AD	10	30	A	45	50		40	10	
X-100 + RAMROD	1/4+2	95	88	S	98	76	S	5	0	S	0	0		0	0	
	1/2+2	95	92	S	99	97	S	15	30	A	0	0		0	0	
	1/4+3	100	100	AD	100	97	S	5	0	S	0	0		0	0	
	1/4+3	95	100	A	95	100	A	65	30	S	0	0		0	0	
CONTROL	-	0	0		0	0		0	0		0	0		0	0	

X-100 = 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione
Atrazine = 2-chloro-4-(ethylamino)-6-isopropylamino)-s-triazine
Lasso = 2-chloro-2',6'-diethyl-N-(methoxymethyl)acetanilide
Amiben = 3-amino-2,5-dichlorobenzoic acid
Prowl = N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine
Ramrod = 2-chloro-N-isopropylacetanilide

TABLE 2

Pre-Emergence

Treatment	Application Rate lb/A	FP O	FP E	FP R	WHM O	WHM E	WHM R	GG O	GG E	GG R	SC O	SC E	SC R	YFT O	YFT E	YFT R	GFT O	GFT E	GFT R
X-100	1/4	20			95			100			15			95			10		
	1/2	100			100			100			95			90			65		
ATRAZINE	1/4	60			0			65			0			45			30		
	1/2	70			40			95			0			80			60		
LASSO	1/2	100			95			100			90			90			100		
	1	100			98			100			100			90			100		
AMIBEN	1	100			95			95			0			75			45		
	2	95			95			100			0			85			85		
PROWL	1/4	100			95			100			90			95			95		
	1/2	100			100			100			100			100			100		
RAMROD	2	75			50			95			0			90			95		
	3	100			90			100			0			98			100		
X-100	1/4+1/4	100	68	S	100	95	S	100	100	AD	100	15	S	90	97	A	100	37	S
+	1/2+1/4	100	100	AD	100	100	AD	100	100	AD	95	95	AD	95	94	S	100	75	S
ATRA-	1/2+1/2	95	75	S	100	97	S	100	100	AD	90	15	S	90	99	A	100	64	S
ZINE	1/2+1/2	100	100	AD	100	100	AD	100	100	AD	100	95	S	100	98	S	100	86	S
X-100	1/4+1/2	100	100	AD	100	100	AD	100	100	AD	90	91	A	85	99	A	100	100	AD
+	1/2+1/2	100	100	AD	100	100	AD	100	100	AD	98	93	A	100	99	S	100	100	AD
LASSO	1/4+1	100	100	AD	100	100	AD	100	100	AD	95	100	A	100	99	A	100	100	AD
	1/2+1	100	100	AD	100	100	AD	100	100	AD	98	100	A	100	99	S	100	100	AD
X-100	1/4+1	100	100	AD	100	100	AD	100	100	AD	100	15	S	98	99	A	100	50	S
+	1/2+1	100	100	AD	100	100	AD	100	100	AD	98	95	S	98	98	AD	100	81	S
AMIBEN	1/4+2	100	96	S	100	100	AD	100	100	AD	70	15	S	80	99	A	100	86	S
	1/2+2	100	100	AD	100	100	AD	100	100	AD	98	95	S	95	98	A	95	95	AD

TABLE 2
(continued)

Application Treatment	Rate lb/A	FP O	FP E	FP R	WPM O	WPM E	WPM R	GG O	GG E	GG R	SC O	SC E	SC R	YFT O	YFT E	YFT R	GFT O	GFT E	GFT R
X-100 + PROWL	1/4+1/4	100	100	AD	98	100	A	100	100	AD	95	91	S	100	100	AD	100	95	S
	1/2+1/4	100	100	AD	100	100	AD	100	100	AD	98	99	A	100	99	S	100	98	S
	1/4+1/2	100	100	AD	100	100	AD	100	100	AD	98	100	A	100	100	AD	100	100	AD
	1/2+1/2	100	100	AD	100	100	AD	100	100	AD	100	100	AD	100	100	AD	100	100	AD
X-100 + RAMROD	1/4+2	100	80	S	100	97	A	100	100	AD	90	15	S	100	99	S	100	95	S
	1/2+2	100	100	AD	100	100	AD	100	100	AD	100	95	S	100	99	S	100	98	S
	1/4+3	100	100	AD	100	100	AD	100	100	AD	65	15	S	100	100	AD	100	100	AD
	1/4+3	100	100	AD	100	100	AD	100	100	AD	85	95	A	100	100	AD	100	100	AD
CONTROL	-	0	0	0	0	0	0	0	0	0	0	0		0	0				

TABLE 3

Pre-Emergence

Treatment	Application Rate lb/A	PW O	PW E	PW R	AMG O	AMG E	AMG R	SP O	SP E	SP R	VL O	VL E	VL R	LG O	LG E	LG R	JG O	JG E	JG R
X-100	1/4	100			100			20			100			75			20		
	1/2	70			100			70			100			100			95		
ATRAZINE	1/4	100			100			0			100			10			0		
	1/2	100			100			55			100			10			45		
LASSO	1/2	90			0			60			65			90			100		
	1	95			10			85			60			100			100		
AMIBEN	1	40			0			50			100			90			95		
	2	80			0			65			100			90			98		
PROWL	1/4	70			0			0			0			80			80		
	1/2	85			0			0			85			100			95		
RAMROD	2	60			0			0			0			50			75		
	3	100			10			60			30			85			95		
X-100	1/4+1/4	100	100	AD	100	100	AD	60	20	S	100	100	AD	100	77	S	85	20	S
+	1/2+1/4	100	100	AD	100	100	AD	90	70	S	100	100	AD	100	100	AD	95	95	AD
ATRA-	1/2+1/2	100	100	AD	100	100	AD	98	64	S	100	100	AD	100	77	S	95	55	S
ZINE	1/2+1/2	100	100	AD	100	100	AD	95	86	S	100	100	AD	100	100	AD	100	97	S
X-100	1/4+1/2	100	100	AD	100	100	AD	85	68	S	100	100	AD	100	97	S	100	100	AD
+	1/2+1/2	100	97	S	100	100	AD	100	88	S	100	100	AD	100	100	AD	100	100	AD
LASSO	1/4+1	100	100	AD	100	100	AD	98	88	S	100	100	AD	100	100	AD	100	100	AD
	1/2+1	100	98	S	100	100	AD	98	95	S	100	100	AD	100	100	AD	100	100	AD
X-100	1/4+1	98	100	A	100	100	AD	90	60	S	100	100	AD	100	97	S	100	96	S
+	1/2+1	100	82	S	100	100	AD	98	95	S	100	100	AD	100	100	AD	98	99	A
AMIBEN	1/4+2	100	100	AD	100	100	AD	80	72	S	100	100	AD	100	97	S	100	93	S
	1/2+2	100	94	S	100	100	AD	85	89	A	100	100	AD	100	100	AD	100	99	S

TABLE 3
(continued)

Treatment	Application Rate lb/A	PW			AMG			SP			VL			ICG			JG		
		O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R
X-100	1/4+1/4	100	100	AD	100	100	AD	60	20	S	100	100	AD	100	95	S	95	84	S
+	1/2+1/4	100	91	S	100	100	AD	85	70	S	100	100	AD	100	100	AD	100	99	S
PROWL	1/4+1/2	100	100	AD	95	100	A	40	20	S	100	100	AD	100	100	AD	100	96	S
	1/2+1/2	100	95	S	98	100	A	75	70	S	100	100	AD	100	100	AD	100	99	S
X-100	1/4+2	100	100	AD	100	100	AD	100	20	S	100	100	AD	100	87	S	65	80	A
+	1/2+2	100	88	S	100	100	AD	90	70	S	100	100	AD	100	100	AD	80	96	A
RAMROD	1/4+3	100	100	AD	100	100	AD	85	68	S	100	100	AD	100	96	S	80	96	A
	1/4+3	100	100	AD	100	100	AD	90	88	S	100	100	AD	100	100	AD	95	99	A
CONTROL	-	0	0	0	0	0	0	0	0	0	0	0		0	0				

TABLE 4

Post-Emergence

Application Treatment	Rate lb/A	PW			CB			AMG			SP			VL			YGS		
		O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R
X-100	1/4	70			80			75			20			100			60		
	1/2	65			95			100			50			100			90		
ATRAZINE	1/4	100			100			100			40			100			20		
	1/2	100			100			100			60			100			35		
X-100	1/4+1/4	100	100	AD	100	100	AD	100	100	AD	55	52	S	100	100	AD	85	84	A
+	1/2+1/4	100	100	AD	100	100	AD	100	100	AD	70	70	AD	100	100	AD	95	92	S
ATRA-	1/2+1/2	100	100	AD	100	100	AD	100	100	AD	90	68	S	100	100	AD	90	87	A
ZINE	1/2+1/2	100	100	AD	100	100	AD	100	100	AD	100	80	S	100	100	AD	90	94	A
CONTROL	-	0	0	0	0	0	0	0	0	0	0	0		0	0				

TABLE 5

Post-Emergence

Application Treatment	Rate lb/A	LCG			JG			WHM			FP			GG			[illegible]		
		O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R
X-100	1/4	100			100			95			75			70			45		
	1/2	100			100			90			80			80			60		
ATRAZINE	1/4	85			25			35			20			65			20		
	1/2	75			20			35			40			60			10		
X-100	1/4+1/4	100	100	AD	95	100	A	95	97	A	80	80	AD	70	90	A	45	66	A
+	1/2+1/4	100	100	AD	100	100	AD	100	94	S	60	84	A	90	93	A	60	68	S
ATRA-	1/2+1/2	100	100	AD	90	100	A	100	97	S	100	85	S	100	88	S	35	51	A
ZINE	1/2+1/2	100	100	AD	100	100	AD	100	94	S	75	88	A	100	92	S	40	64	A
CONTROL	-	0	0	0	0	0	0	0	0	0	0	0		0	0				

TABLE 6

Post-Emergence

Application Treatment	Rate lb/A	SA			RJG			YFT			GFT			CORN 55A			CORN 23A		
		O	E	R	O	E	R	O	E	R	O	E	R	O	E	R	O	E	R
X-100	1/4	80			0			75			75			0			0		
	1/2	90			20			85			90			0			0		
ATRAZINE	1/4	100			0			65			70			0			0		
	1/2	95			0			65			75			0			0		
X-100	1/4+1/4	100	100	AD	0	0	AD	75	91	A	70	93	A	0	0		0	0	
+	1/2+1/4	95	100	A	10	20	A	100	95	S	100	97	S	0	0		0	0	
ATRA-	1/2+1/2	100	99	S	10	0	S	100	91	S	98	94	S	0	0		0	0	
ZINE	1/2+1/2	100	100	AD	0	20	A	98	95	S	95	98	A	0	0		0	0	
CONTROL	-	0	0	0	0	0	0	0	0	0	0	0		0	0				

[illegible] depend upon the [illegible] and the degree of control desired. In general, the compositions of this invention are most efficiently employed at a rate of 0.01 to 50 pounds per acre (0.011 to 56 kilograms per hectare) of the active ingredients, preferably 0.1 to 25 pounds per acre (0.11 to 28 kilograms per hectare).

The compositions of the present invention show synergistic activity as herbicides in controlling the growth of undesirable vegetation when applied to such vegetation in pre- or postemergence application. The compositions are generally embodied in formulations which contain inert or occasionally active ingredients or diluent carriers in addition to the active compounds. Examples of such ingredients or carriers are water, organic solvents, surface active agents, oil, water-in-oil emulsions, wetting agents, dispersing agents, and emulsifying agents. The herbicidal formulations generally take the form of wettable powders, solutions or emulsifiable concentrates.

Wettable powders are finely divided compositions comprising a particulate carrier impregnated with the herbicidal compound and additionally containing one or more surface active agents. The surface active agent promotes rapid dispersion of the powder in aqueous medium to form stable, sprayable suspensions. A wide variety of surface active agents can be used, for example, long chain fatty alcohols and alkali metal salts of the sulfated fatty alcohols; salts of sulfonic acid; esters of long chain fatty acids; and polyhydric alcohols, in which the alcohol groups are free, omega-substituted polyethylene glycols of relatively long chain length.

The herbicidal compositions can also be applied to the foliage in the form of a solution in a suitable solvent. Solvents frequently used in herbicidal formulations include kerosene, fuel oil, xylene, petroleum fractions with boiling ranges above xylene, and aromatic petroleum fractions rich in methylated naphthalenes.

The most preferred formulations are emulsifiable concentrates which consist of an oil solution of the herbicide along with an emulsifying agent. Prior to use the concentrate is diluted with water to form a suspended emulsion of oil droplets. The emulsifiers used are usually a mixture of anionic and nonionic surfactants. Other additives such as spreading agents and stickers can be included in the emulsifiable concentrate.

The formulations described above can be applied to the vegetation sought to be controlled in any conventional manner either before or after the vegetation has emerged from the soil. The vegetation can be in any stage of development after emergence, ranging from seedlings to fully grown plants. Application can be achieved by any conventional technique such as the use of ground spraying equipment or aircraft-mounted sprayers. Various other application techniques will be apparent to one skilled in the pesticide art.

1. A synergistic herbicidal composition comprising a mixture of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof;

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

2. The composition of Claim 1 wherein (b) is 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine.

3. The composition of Claim 1 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

4. The composition of Claim 1 wherein (b) is 2-chloro-N-isopropylacetanilide.

5. A synergistic herbicidal composition comprising a mixture of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; and

(c) an inert diluent carrier,

at a weight ratio of (a) to (b) of from about 0.01:1 to about 20:1.

6. The composition of Claim 5 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

7. A method of controlling undesirable vegetation which comprises the application to said vegetation of a herbicidal composition comprising

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof,

at a weight ratio of (a) to (b) of from about 0.1:1 to about 30:1.

8. The method of Claim 7 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

9. The method of Claim 7 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

10. The method of Claim 7 wherein (b) is 2-chloro-N-isopropylacetanilide.

[illegible] for preparing
[illegible] herbicidal composition comprising [illegible] mixing

[illegible] herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof;

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

2. The process of Claim 1 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

3. The process of Claim 1 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

4. The process of Claim 1 wherein (b) is 2-chloro-N-isopropylacetanilide.

5. A process for preparing a synergistic herbicidal composition comprising mixing of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; and

(c) an inert diluent carrier,

at a weight ratio of (a) to (b) of from about 0.01:1 to about 20:1.

6. The process of Claim 5 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

7. A method of controlling undesirable vegetation which comprises the application to said vegetation of a herbicidal composition comprising

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof,

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

8. The method of Claim 7 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

9. The method of Claim 7 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

10. The method of Claim 7 wherein (b) is 2-chloro-N-isopropylacetanilide.

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof,

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

8. The method of Claim 7 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

9. The method of Claim 7 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

10. The method of Claim 7 wherein (b) is 2-chloro-N-isopropylacetanilide.

CLAIMS TO BE CLAIMED IS:

A process for preparing
a synergistic herbicidal composition comprising mixing

of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof;

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

2. The process of Claim 1 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

3. The process of Claim 1 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

4. The process of Claim 1 wherein (b) is 2-chloro-N-isopropylacetanilide.

A process for preparing
5. a synergistic herbicidal composition comprising mixing

of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; and

(c) an inert diluent carrier,

at a weight ratio of (a) to (b) of from about 0.01:1 to about 20:1.

6. The process of Claim 5 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

7. A method of controlling undesirable vegetation which comprises the application to said vegetation of a herbicidal composition comprising

11. A synergistic herbicidal composition comprising a mixture of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof;

at a weight ratio of (a) to (b) of from about 0.1:1 to about 20:1.

12. The composition of Claim11 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

13. The composition of Claim11 wherein (b) is 3-amino-2,5-dichlorobenzoic acid.

14. The composition of Claim11 wherein (b) is 2-chloro-N-isopropylacetanilide.

15. A synergistic herbicidal composition comprising a mixture of:

(a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione;

(b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; and

(c) an inert diluent carrier,

at a weight ratio of (a) to (b) of from about 0.01:1 to about 20:1.

16. The composition of Claim15 wherein (b) is 2-chloro-4-(ethylamino)-6-(isoproylamino)-s-triazine.

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(54) Synergistic herbicide combinations and method of application.

(57) A synergistic herbicidal composition comprising a mixture of: (a) a herbicidally effective amount of 2-(2-chloro-4-methanesulfonylbenzoyl)-1,3-cyclohexanedione; and (b) a herbicidally effective amount of a compound selected from the group consisting of 2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine, 3-amino-2,5-dichlorobenzoic acid, and 2-chloro-N-isopropylacetanilide, and mixtures thereof; at a weight ratio of (a) to (b) to from about 0.1:1 to about 20:1.

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European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP 86 11 7331

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X,D	EP-A-0 137 963 (STAUFFER CHEM. CO.)		A 01 N 43/70
	* Page 19, lines 4-37; claims 1-6, 18,20-25,37 *	1,2,5-8	A 01 N 41/10// (A 01 N 43/70 41:10)

A	THE PESTICIDE MANUAL, 6th edition, 1979, page 22; C.R. Worthing, The British Crop Protection Council, Croydon, Surrey, GB		(A 01 N 41/10 37:44 37:22)
	* Page 22 *	1,2,5-8	

TECHNICAL FIELDS SEARCHED (Int Cl.4)
A 01 N

Place of search	Date of completion of the search	Examiner
The Hague	16-04-1987	FLETCHER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid,

namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions,

namely:

1) Claims 1,2,5-8: Synergistic herbicidal composition comprising a mixture of (a) and 2-chloro-4-ethylamino-6-isopropyl-amino-S-triazine

2) Claims 1,3,5,7,9: (a) and 3-amino-2,5-dichlorobenzoic acid

3) Claims 1,4,5,7,10: (a) and 2-chloro-N-isopropylacetanilide

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid,

namely claims:

☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims,

namely claims: 2,6,8 and 1,5,7 partially